ROLES AND RESPONSIBILITIES

- Discretized governing equations of 2D heat equation of steady state and transient state heat transfer using finite difference methods for simple box with constant temperature B.Cs on all four sides

- Developed matlab codes to solve steady state and transient state (implicit and explicit schemes) equations of 2D heat equation using 3 different numerical methods (Jacobi,Gauss Siedel and Successive Over Relaxation methods)

- Determined computational time of these solutions and plotted its tradeoff with accuracy of solution

CODE SNIPPETS – A GLANCE

$$\frac{\partial T}{\partial t} = 0$$

$$\frac{\partial^2 T}{\partial x^2} + \frac{\partial^2 T}{\partial y^2} = 0$$

$$\frac{\partial^2 T}{\partial x^2} = \frac{T_{i-1,j} - 2 * T_{i,j} + T_{i+1,j}}{\Delta x^2}$$

$$\frac{\partial^2 T}{\partial y^2} = \frac{T_{i,j-1} - 2 * T_{i,j} + T_{i,j+1}}{\Delta y^2}$$

We take nx = ny (given),

This implies $\Delta x = \Delta y$

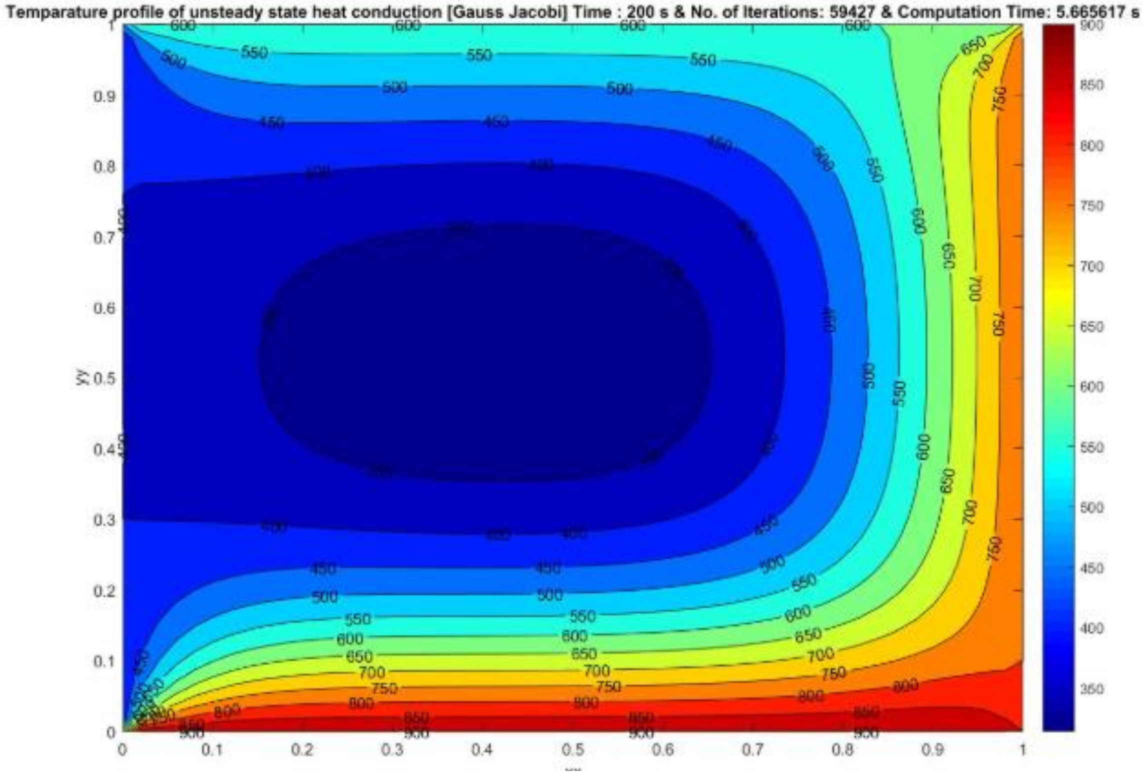
$$\frac{T_{i-1,j} - 2 * T_{i,j} + T_{i+1,j} + T_{i,j-1} - 2 * T_{i,j} + T_{i,j+1}}{\Delta x^2} = 0$$

$$T_{i,j} = \frac{1}{4}(T_{i-1,j} + T_{i+1,j} + T_{i,j-1} + T_{i,j+1})$$

```
clear all
close all
clc
% Defining lenghts of domain
Lx=1;
Ly=1;
% Defining the number of mesh points and w
w=1.56;
nx=ny=10;
% Dividing the lengths along x and y directions
x=linspace(0,Lx,nx);
dx=x(2)-x(1);
y=linspace(0,Ly,ny);
dy=y(2)-y(1);
% Defining tolerance and error
error=1e-3;
tol=1e-4;
T=ones(nx,ny);
% Defining BCs and a copy of T
Told=T;
T(1,:)= 600;
T(end,:)= 900;
T(:,1)= 400;
T(:,end)= 800;
iterative_solver = 3;
```

```
iterative_solver = 3;
%Jacobi method
if iterative_solver == 1
    jacobi_iter = 1;
   while(error>tol)
     for i=2:nx-1
     for j=2:ny-1
     T(i,j)= 0.25*(Told(i-1,j)+Told(i+1,j)+Told(i,j-1)+Told(i,j+1));
     end
     end
     contourf(T);
     title_text=sprintf('iteration number=%d',jacobi_iter);
     title(title_text);
     pause(0.003);
     error=max(max((abs(Told-T))));
     Told=T;
     jacobi_iter = jacobi_iter + 1;
   end
end
%Gauss Sidel method
if iterative_solver ==2
   Gaus_Sidel_iter=1;
   while (error>tol)
    for i=2:nx-1
    for j=2:ny-1
    T(i,j)= 0.25*(T(i-1,j)+Told(i+1,j)+T(i,j-1)+Told(i,j+1));
    end
    end
    contourf(T)
```

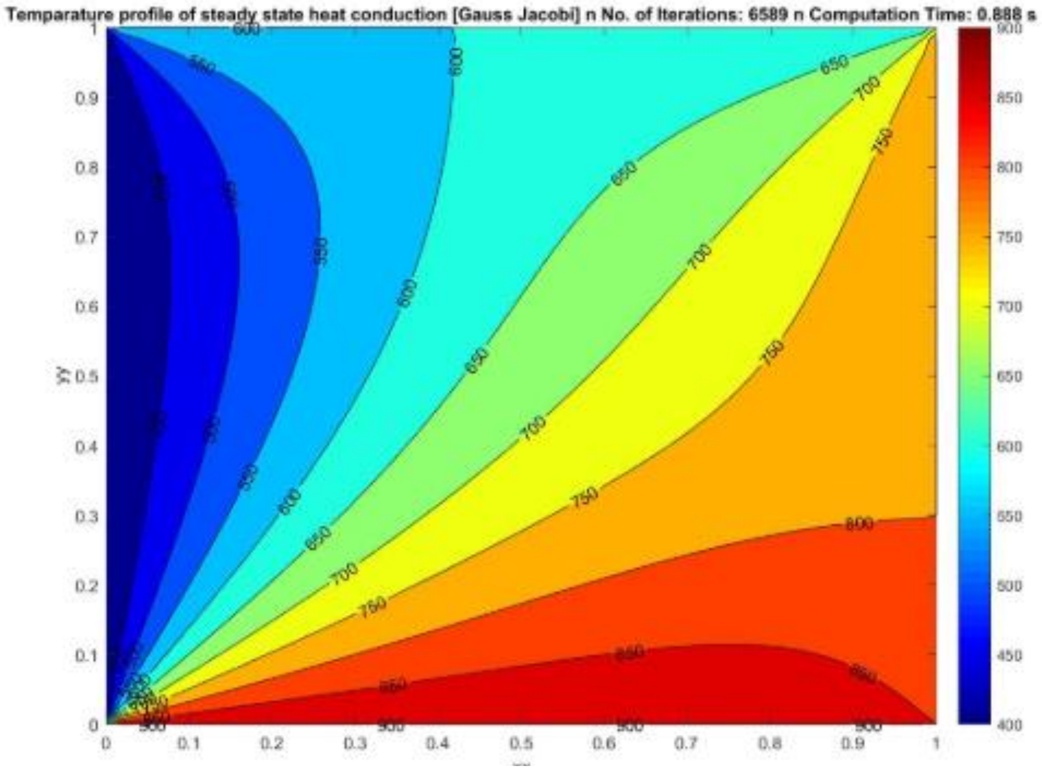
RESULT SNIPPETS



B. Unsteady State solution(Implicit method):

The observations of the unsteady Steady state solution is tabulated below:

Iterative solver	No. of iteratons	Time taken(sec)
jacobi	374	0.152521
Gauss Seidel	201	0.094432
Successive Over Relaxation	101	0.459516



A. Steady state solution:

The observations of the Steady state solution is tabulated below:

Iterative solver	No. of iteratons	Time taken(sec)
jacobi	869	0.285706
Gauss Seidel	463	0.147559
Successive Over Relaxation	79	0.028754